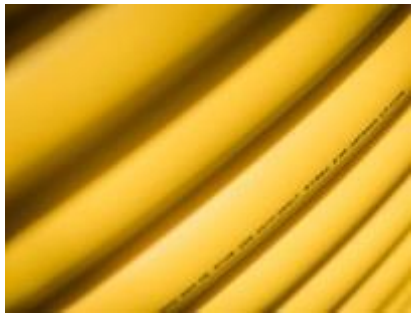
Duke Energy / Piedmont Natural Gas
Satellite Methane Detection & Use Case







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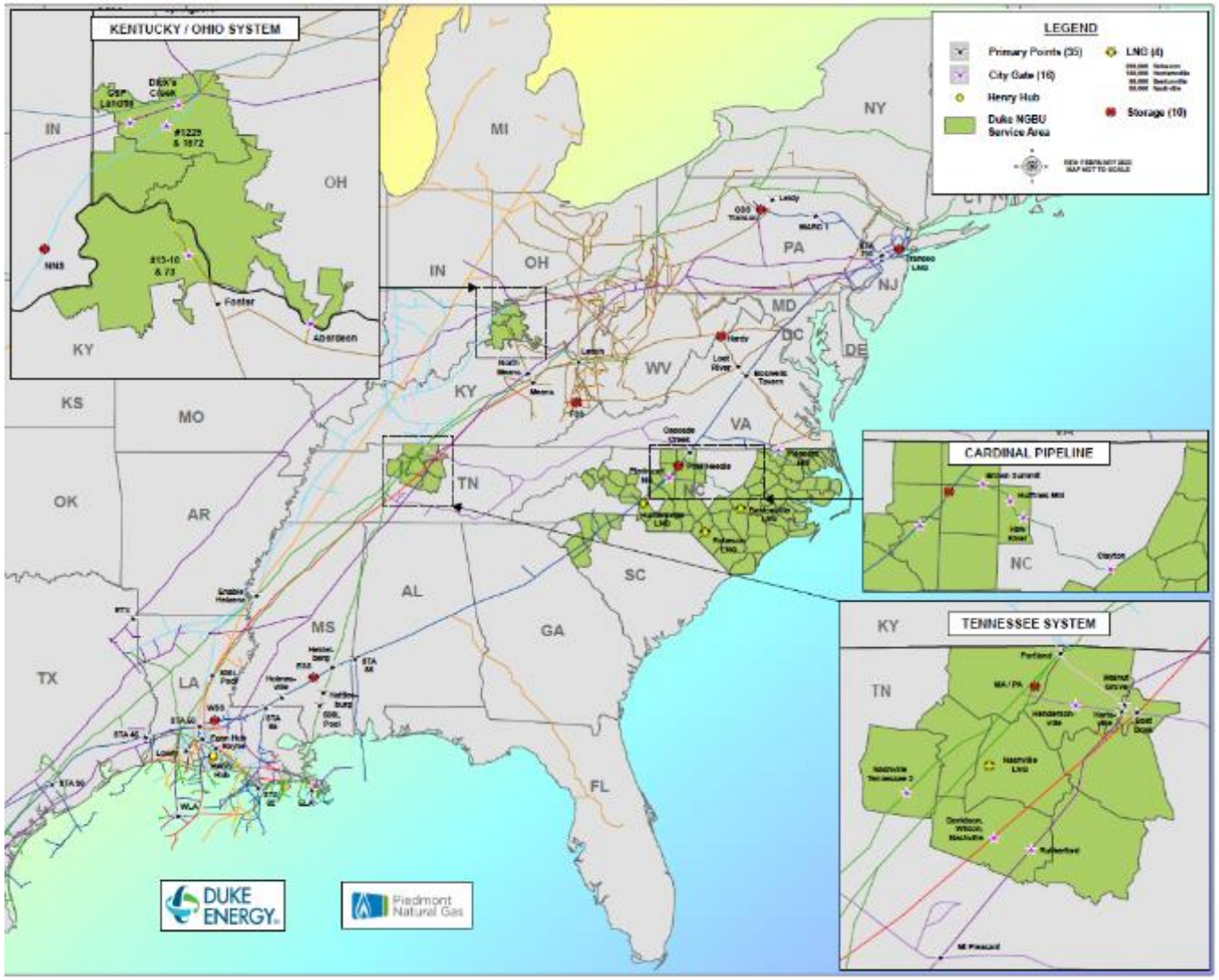
KGA Expo
March 14, 2023

Piedmont Natural Gas

Duke Energy/Piedmont Natural Gas Utility Business



- 1.7 M customers in 5 states
- ~32,000 miles distribution main
- ~2,900 miles intrastate transmission main
- 5 compression stations
- 4 Liquified Natural Gas (LNG) sites
- 2,000+ employees in NGBU

Our Climate Strategy is Our Business Strategy

Environmental

Seizing the opportunity to deliver cleaner energy.

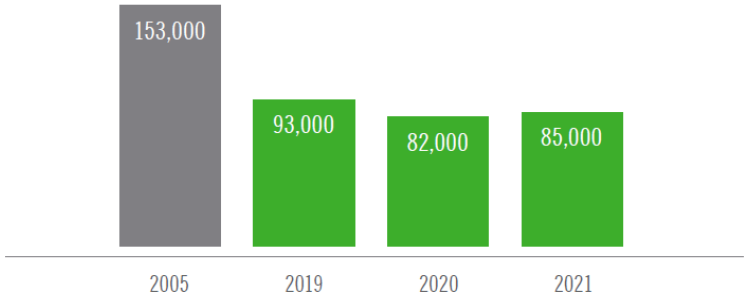
GOAL STATUS
- Achieved or on track
- Currently not on track due to pandemic
- Target not achieved

ENVIRONMENTAL GOALS:

- **Carbon emissions:** Reduce the carbon dioxide (CO_2) emissions from our generation fleet (Scope 1 emissions) by at least 50% from the 2005 level by 2030 (equates to a reduction from 153 million short tons to 75.5 million short tons), and attain net-zero emissions by 2050.

  2021 status: Our generation fleet emitted about 85 million short tons (77 million metric tons) of CO_2, a reduction of over 44% from the 2005 level. In 2021, CO_2 emissions were somewhat higher than in 2020 due to increased generation as the economy began to rebound, though the long-term reduction trend continued.

Carbon Dioxide Emissions from Electric Generation
(thousand short tons)



- **Methane emissions:** Achieve net-zero methane emissions from our natural gas distribution business by 2030 (Scope 1 emissions).

  2021 status: See Methane Detection and Reduction of Emissions.

New goals for the Electric Utilities:
- Reduce emissions from electricity purchased for company use (Scope 2 emissions) to net-zero by 2050.
- Reduce greenhouse gas emissions from the power we purchase for resale (Scope 3 emissions) to net-zero by 2050.
- Reduce greenhouse gas emissions from the procurement of fossil fuels used for generation (Scope 3 emissions) to net-zero by 2050.

New goals for the Natural Gas Local Distribution Business:
- Reduce greenhouse gas emissions from upstream methane and carbon emissions related to purchased natural gas (Scope 3 emissions) to net-zero by 2050.
- Reduce downstream carbon emissions from customers' consumption of natural gas (Scope 3 emissions) to net-zero by 2050.

Scope 1, 2 & 3 Emissions – The Natural Gas Supply Chain

Producers
Midstream Pipelines
Storage Facilities

Scope 3 Upstream

LDC Assets
Pipelines & Meters
Regulator Stations
On System Storage

Scope 1

Customer Use
Residential
Commercial
Industrial (Sales)

Scope 3 Downstream

Taking Action to Measure and Reduce Methane Emissions

Measuring & Reducing Emissions

"Today, the Oil and Gas Industry has a methane emissions data problem. The majority of emissions data is derived from desktop calculations (EPA) informed by engineering equations, not real-world measurements.

Improving the accuracy of emission estimates is necessary to instill confidence that progress is being made."

- EDF Article "Hitting the Mark" (2020)

Near real-time measurement of methane emissions is required

- To establish a baseline of emissions
- To measure emission reductions over time
- To show achievement of net-zero by 2030

Methane Emission Reduction Work Underway

Multiple projects to reduce or eliminate methane emissions on our LDC system are underway with impressive results

- On-going captures of actual methane emissions in pilot areas
- Ground validation
- Goal for “real-time” leak surveys of all LDC assets

- Incorporated into major project LDC work
- Currently working to incorporate into standard operating procedures procedures/processes
- Pilot for distribution projects scheduled to begin in mid 2022

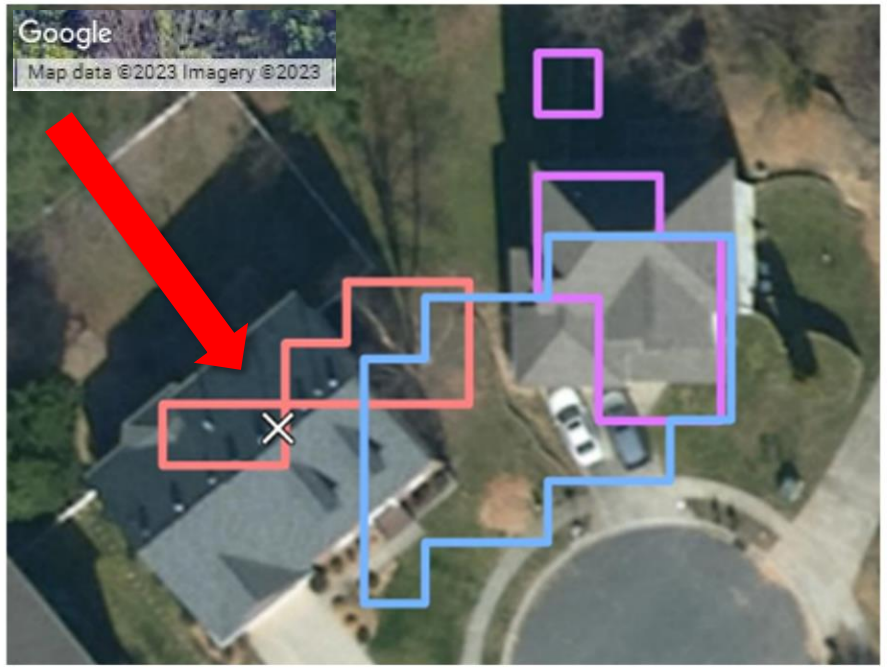
- Pilot scheduled to begin in Fall 2022 at LNG facility & compressor station
- Will provide 24/7 surveillance of methane emissions
- Pilot for other GCI devices at three regulator stations scheduled for pilot in late 2022

- Cadence of leak surveys changed from five years to three years
- Process improvements to clear leak inventories faster
- Leak inventory reduced by more than 74% within 18-month period

Methane Emission Reduction Work Underway

2023 Outcomes: Scaling the use of methane detection and quantification technologies & shaping the regulatory landscape.

- Open Leak Backlog Reduction
- Find It / Fix It Model
- Concurrent Leak Survey Program & Satellite Plume Investigations – NC
- Learnings - Confirming if Leak Fixed



X = Repaired Leak Condition on 6/27/22
Polygons = Methane Detection on 8/13, 9/1 & 9/14

- Scaling captures to all NC
- AI Improvements
  - Plume to Leak Source Location Accuracy
  - Ability to Identify Recurrent Plumes
- Refining Flow Rate Measurement and Estimations

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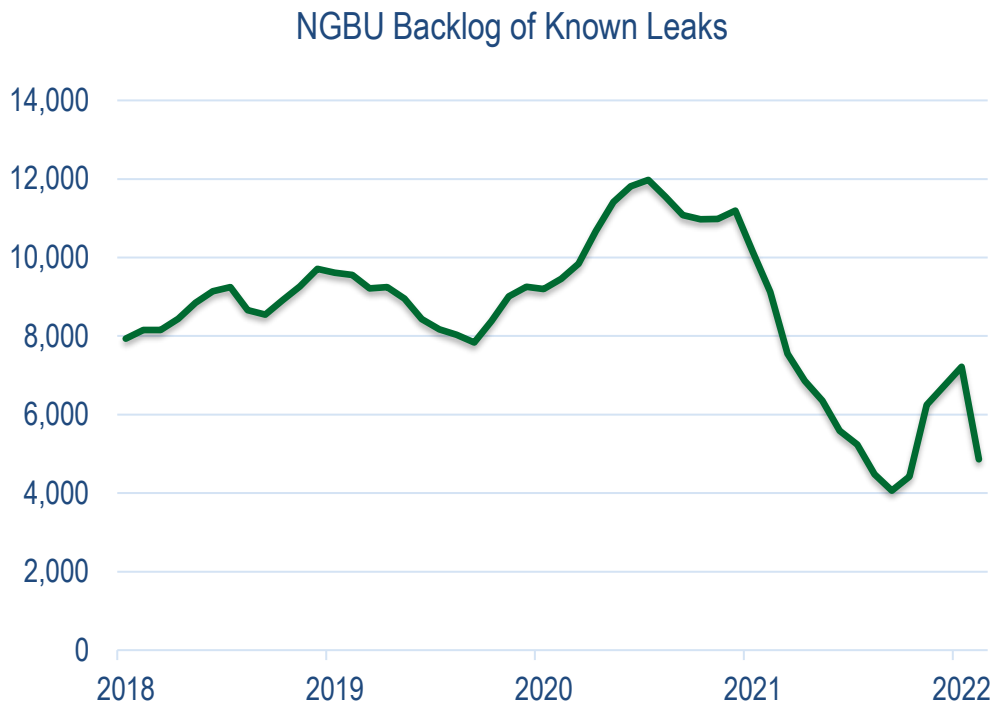
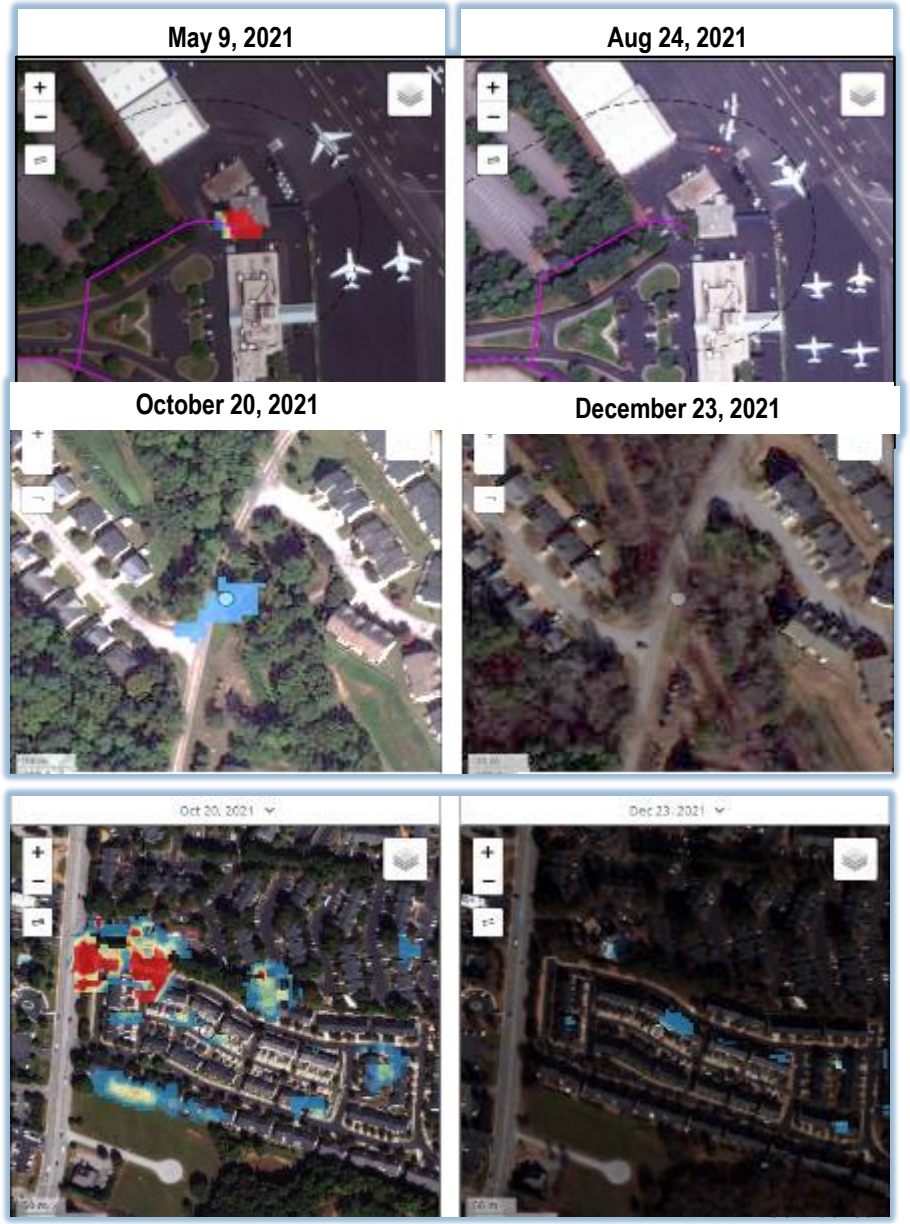
Technology to Transform Methane Leak Detection Practices

- Utilizing satellite technology to detect methane leaks allows for resources to focus on the repair of leaks
- Shift field practices from “find the leak, grade it for later” to “find the leak, fix the leak”
- Partnering with Accenture and Microsoft to develop methane data platform for Gas LDCs to achieve net-zero goals



Shift to “Find it, Fix it” Leak Repair Practice

Long Term Goal – Zero Leak Inventory



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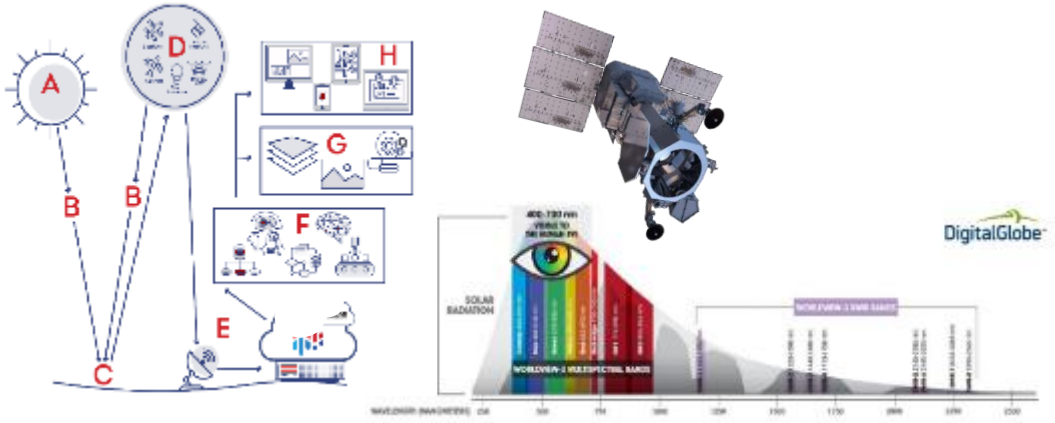
Advanced Methane Leak Detection (AMLD) tools

Industry leading initiatives to reduce Scope 1 emissions to net-zero by 2030

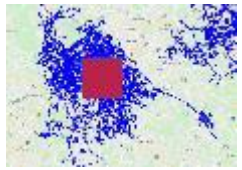
- Utilizing several advanced technologies to “see” and detect methane leaks in real-time
- Advocating for EPA to adopt new measurement technology for methane reporting
  - Current EPA reporting methodology utilizes emission factors and driven by miles of pipeline and number of customer meters

Satellite Methane Detection and Image Analytics



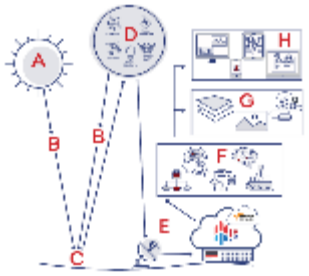
Gas Cloud Imaging (GCI) Cameras

How it Works – AMLD Pilot Process with Satellite



- All Natural Gas Asset Buffers Provided for Area of Interest
- Duke/Satelytics Coordinate Date/Time of Capture

1X Month



- Weather dependent
- 3.7M Short Wave Infrared Resolution (SWIR) sensor on satellite
- Light and portions of electromagnetic spectrum from sun reflected off objects into aerial sensor
- AI/ML algorithms isolate spectral signatures within images; using ratios, bands and computing techniques to detect presence of methane within range of Duke Natural Gas assets

1-4 Days for Tasking

Azure PAR

- Data Delivered
- Classification of New/Known Methane Indications
- Prioritization Algorithm risk ranks methane indications
- Generate Work Orders for Field Response

~48 Hour Data Delivery

- Response to Work Orders by Priority
- Pin/Point and Grade using standard methods and measurement tools
- Field documents findings and creates condition which drives repair timelines (Grade 1, 2, 3)
- Hazardous leaks follow standard process of issuing an emergency order for a Duke First Responder

~48 Hour Response to High Priority Indications
~1 Week Medium Priority Indications
1-3 Months Low Priorities

- Leak Repaired
- Site Level Measurement of Flow Rate at Time of Repair (Sampling)
- Measure Emissions for Life-cycle of Leak

Goal in 2022 – Fix All Confirmed Leaks Within 6 months of detection

Timeline

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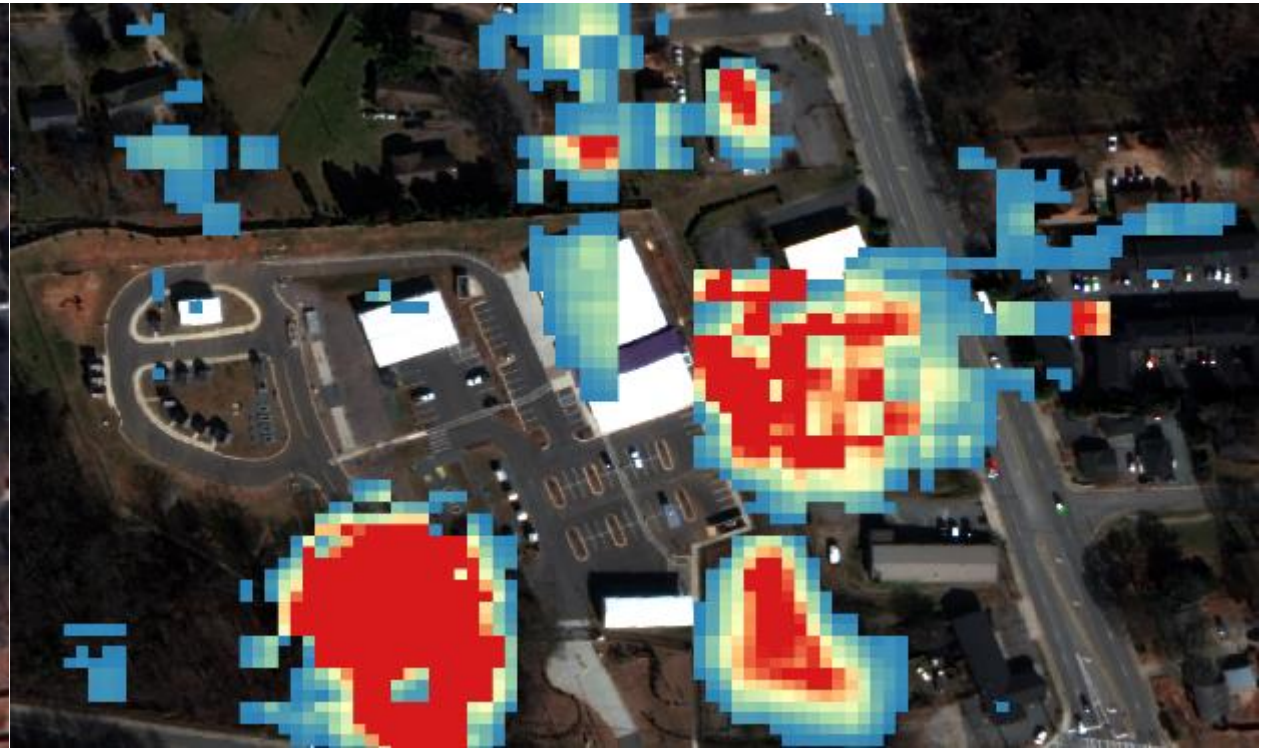
Controlled Release Review – Simulating Leaks During Capture

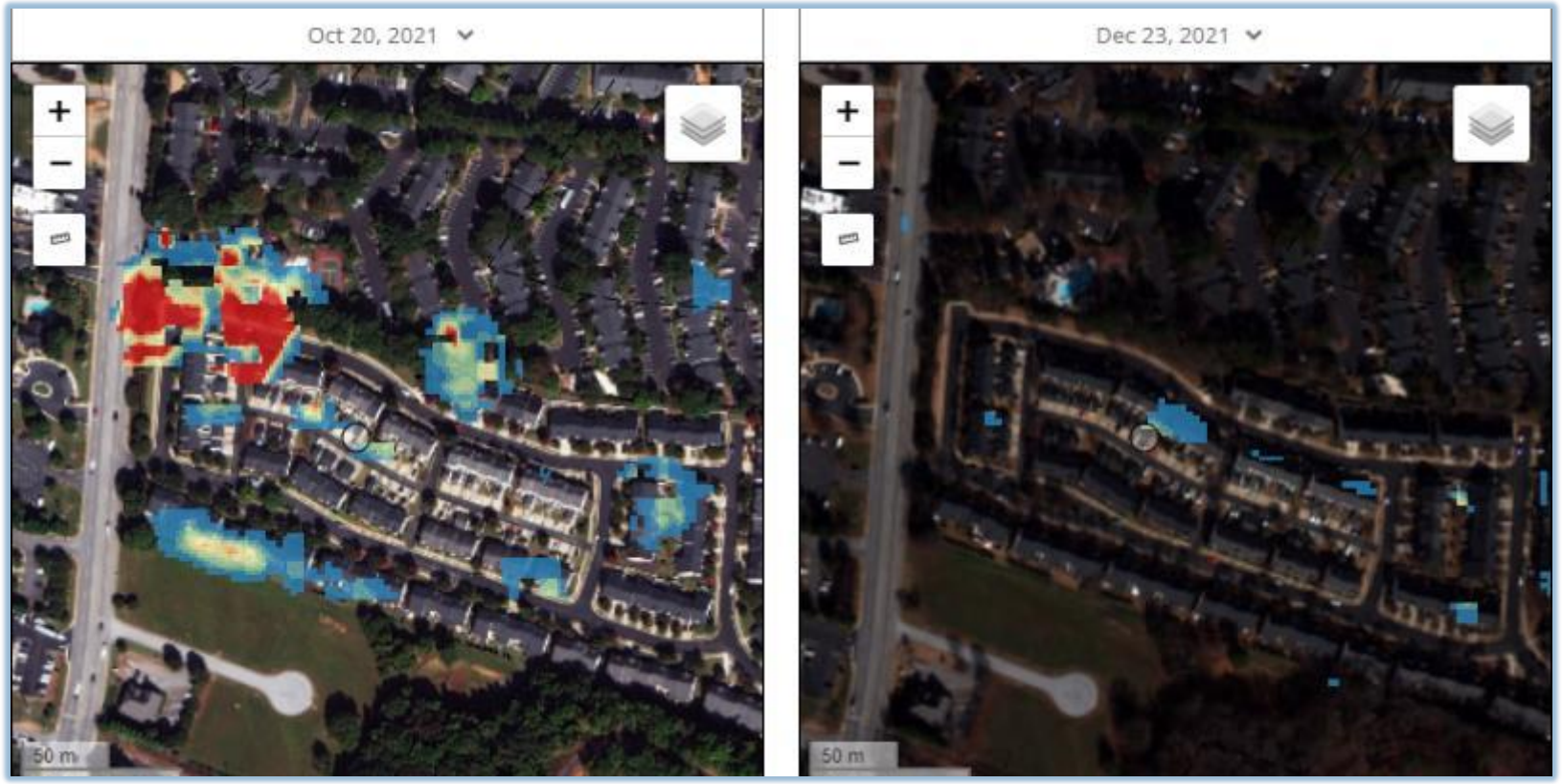
Original Controlled Release - PSA

After Controlled Release AI Refinement - PSA



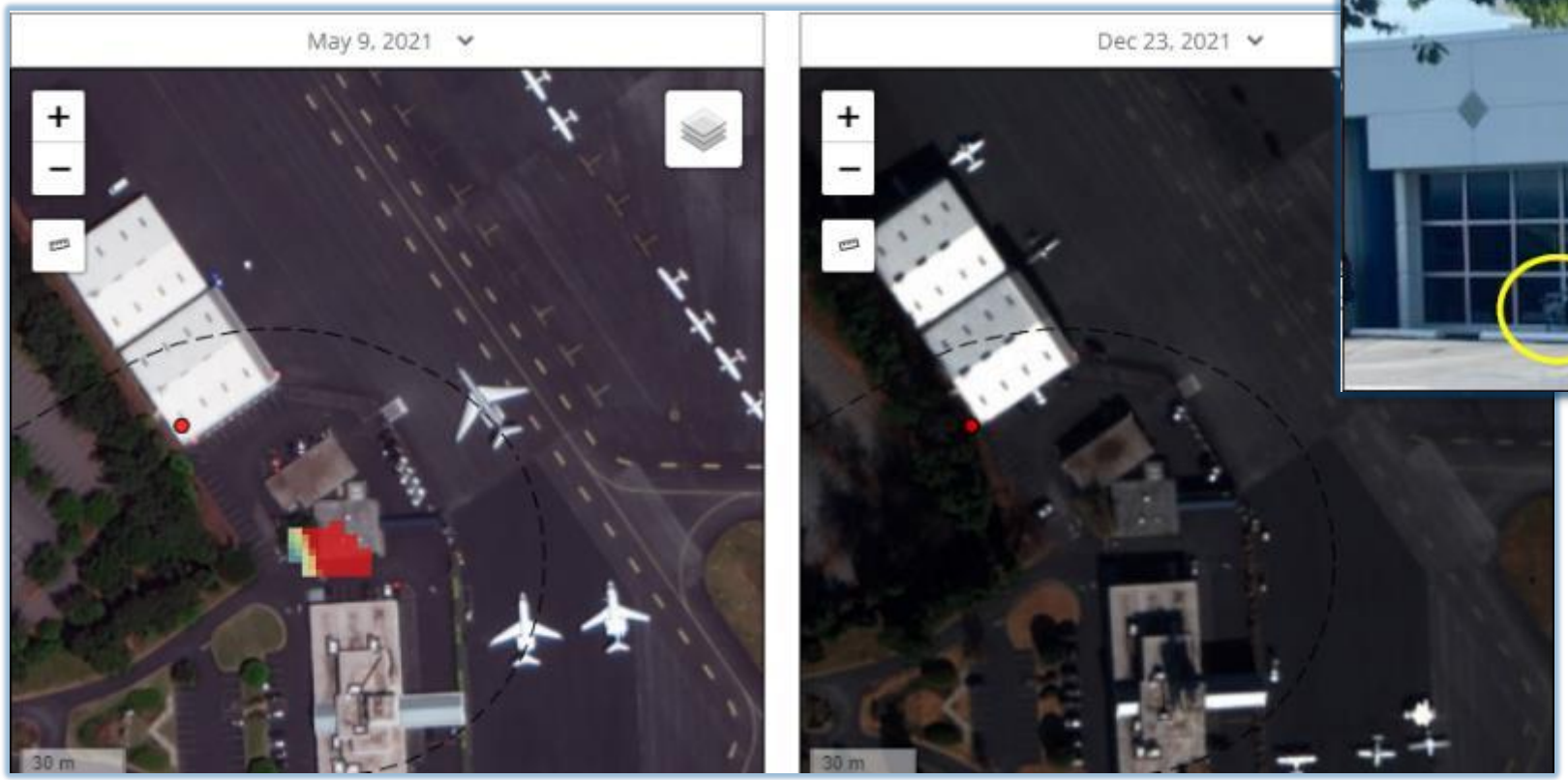
Methane Detection Technology – Goal for "Find it, Fix It Model"

- October satellite capture found several methane plumes over this townhome complex
- *21 confirmed leaks* after site visit leak survey– all above ground, on various components of meter set (risers, union, service stops, regulators)
  - 16 repaired
  - 5 scheduled
- Latest capture in December found a significant reduction in methane plumes/emissions based on repairs complete



Methane Detection Technology – Precision Progress & Results

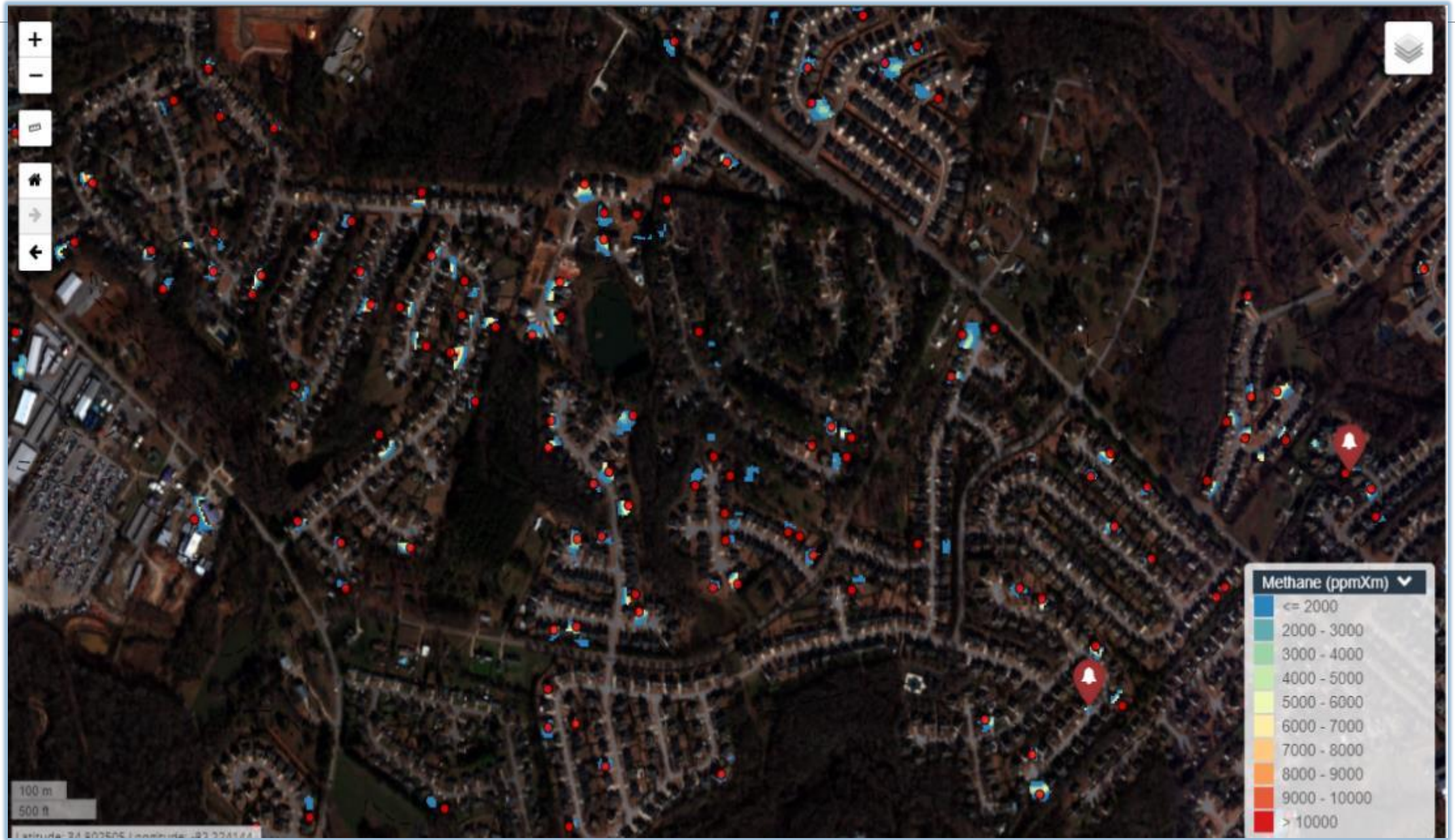
- Our 1st Satellite capture found previously unknown leaks – Ex. Previously unknown leak at airport
- Technician verified and repaired grade 2 leak at regulator
- Latest capture in December found no further emissions from repaired leak



AMLD Pilot– Field Validation Performance Metrics

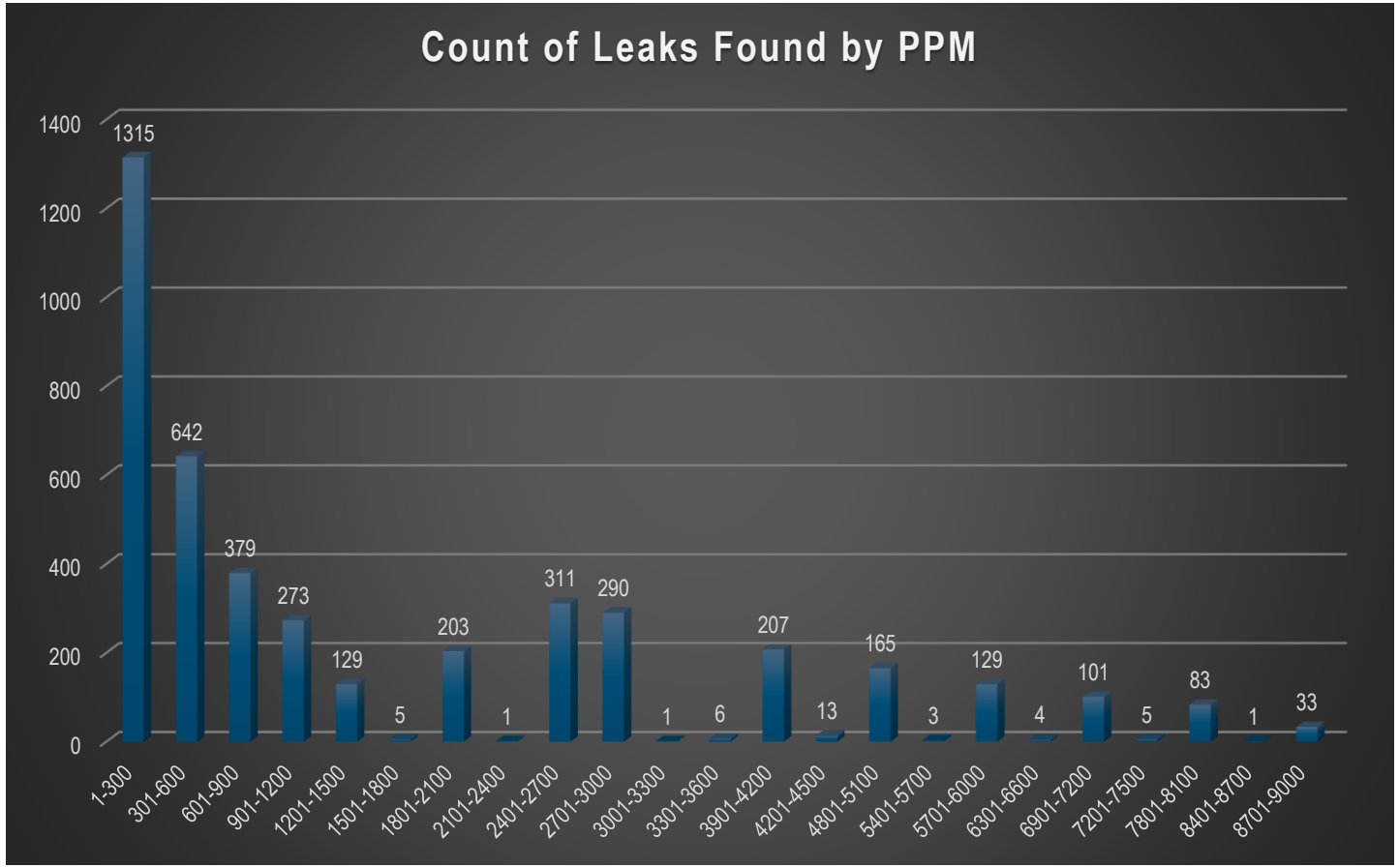
- Plumes versus known open leaks (red dots) from traditional leak survey
- Last 3 capture “hit rate” – averaging 91%
  Hit Rate = satellite successful detection of know open leaks
- Ranging 80-90% “True Positive Confirmed Leak Rate” – During Leak Investigations
- Minimal False Positive Results

AMLD Pilot– Field Validation Performance Metrics

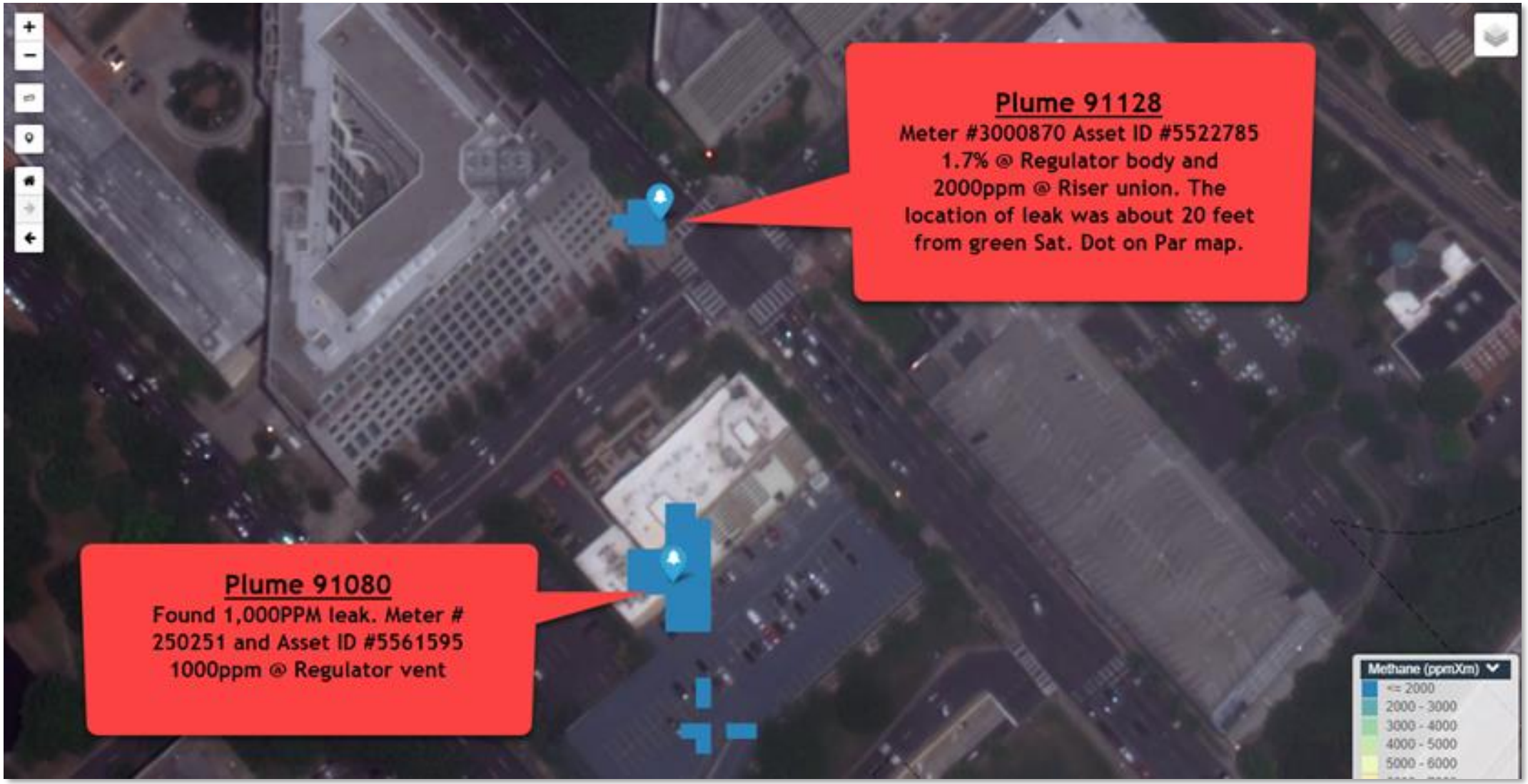


Plume Investigation Results

- To-date, a total of 8,788 Plumes investigated
- 75% less than 2500 PPM
- 30% less than 300 PPM
- 16% No Methane Detected
  - ~ <10% Actual



Urban / Downtown Area Leaks Detected



Urban / Downtown Area Leaks Detected

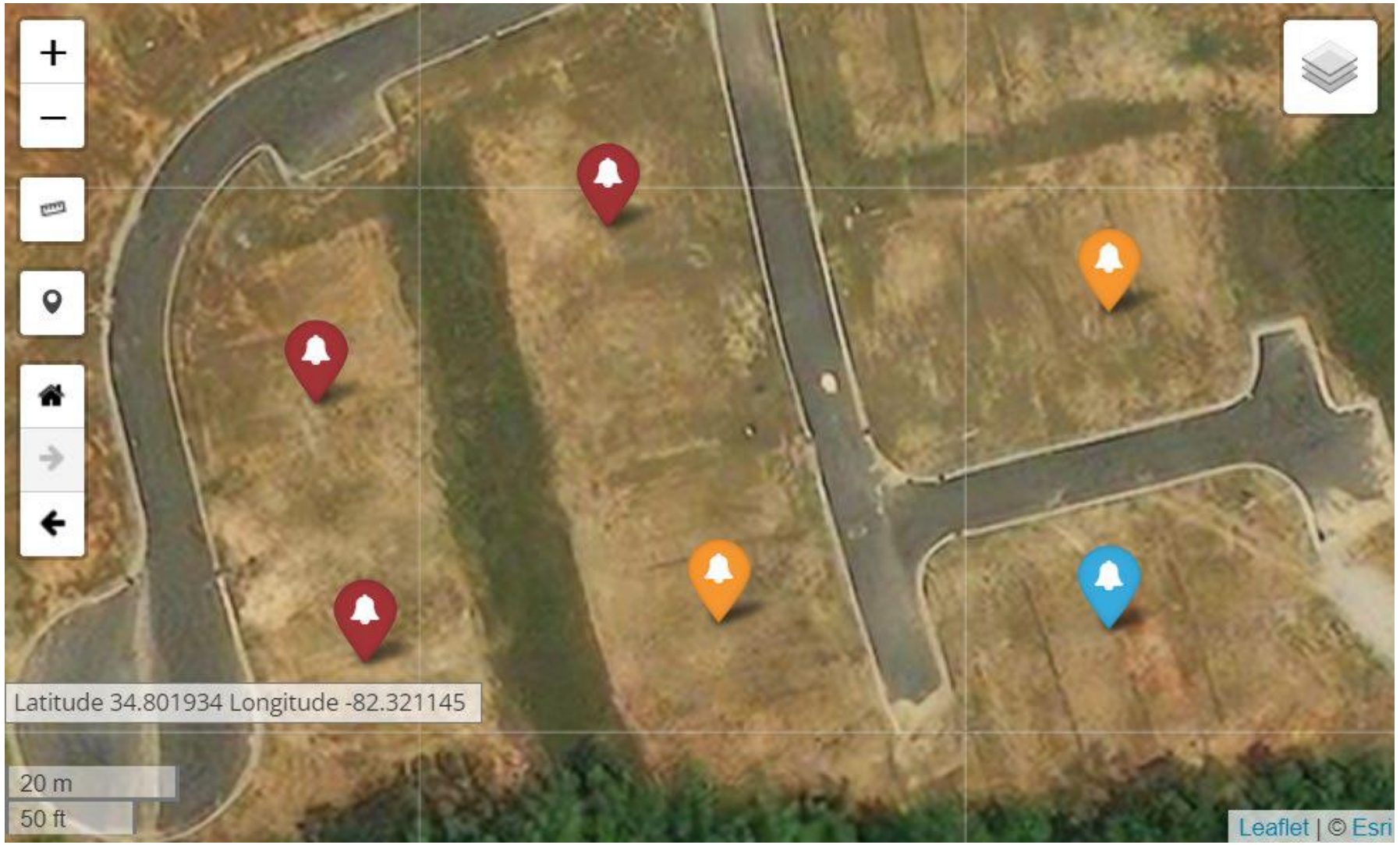
AI/ML Precision and Insights – Key Learnings

- The AI improves rapidly – capture over capture
  - Shadowing, Asphalt, Tree Canopy, Downtown Areas
  - Hit rate on detection of known leaks ranging 90+% (started at 10%)
  - Controlled releases offer “blind” real-time validation mechanism leak conditions and flow rate measurement
- Frequency Matters
  - Seasonal differences – Winter vs Summer
  - Customer Leaks – Beyond the Meter
- False Positives – Low
  - Leaks detected as low as 100 PPM
  - We are finding leaks or naturally occurring methane not part of the LDC system
- Leak Remediation Progress is NOT Linear
  - Learning curve for advancements in detection and how to prioritize remediation

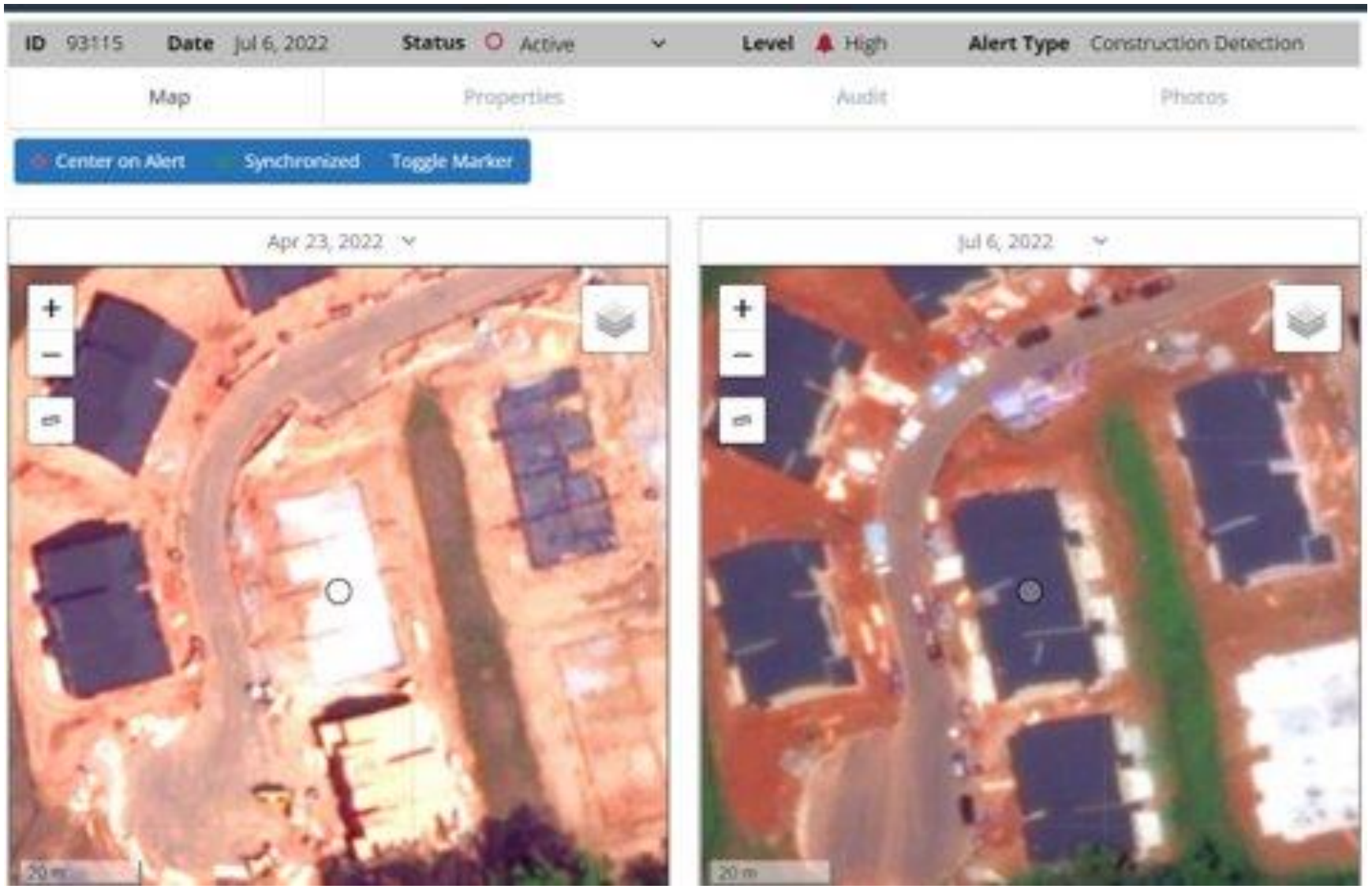
Current Focus

- Conversion from concentration to flow rate and Emissions Rate – *How to measure leaks < 10 scfh to train model*
- Prioritizing leaks using
  - AI estimated grade
  - New or Known
  - Estimated concentration of gas
- Exploring Other Use Cases for the Utility to Transform
  - ROW & Aerial Patrols
  - HCA/MCA Inspections
  - Change Detection
  - Liquid Hydrocarbon Detection
  - Vegetation Growth and Decline
  - New Construction Service Installs

Additional Satellite Use Case - Construction Change Detection



Construction Change Detection



Future State – Methane and Leak Detection Roadmap

Y1 – (Fall 21 – 2022)

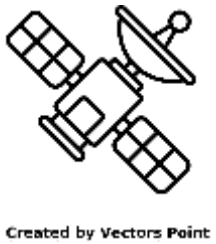
- Complete AMLD Pilot
- Deployed E-Missions Measurement Platform
- Academic Validation
- Flow Rate Accuracy
- Develop Operational Plans to Scale to 5 States
- Start to Socialize with State and Federal Regulatory Bodies
- Operational Completion Leak Inventory Removal

Y2- 2023

- North Carolina Baseline Capture for Measuring Emissions
- Regulatory Buy In
- **Run 1/3 Leak Survey Program in Parallel**
- Pinpoint/Fix Leak in First Visit – **50% Goal

Y3- 2024

- 5-State Baseline Capture for Measuring Emissions
- Adopt AMLD as Primary Leak Survey Method – Stop Traditional Foot Patrol Leak Survey (NC) (not at 100%)
- AI Grades Hazardous vs. Non-Hazardous for Response
- Adopt for Other Compliance Inspection Use Cases – Optimize Operational Costs

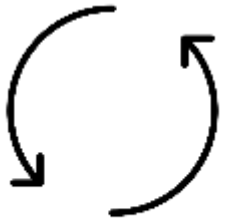


Y4- 2025

- Adopt AMLD as Primary Leak Survey Method across 5-States – Stop Traditional Foot Patrol Leak Survey (not at 100%)
- Achieve Zero Leak inventory - Sustained
- Optimize AMLD Program
- Mature Capital Replacement Programs

Y5- 2026

- Steady State
- Check on Progress Against Baseline and 2030 Goal



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Questions?

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